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A Study on the Significant Influence of Industry Institute Collaboration on Various Factors in Engineering Institutes in Pune Region

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Abstract:

The industry-institute collaboration is one of the major concerns which an engineering institute is currently facing. As we all know the institute's aims at creating new knowledge and providing fundamental education to student, whereas industry focuses on application oriented knowledge which can be transformed into profits of business goals. But the major challenge over here employability for the graduates to transform their knowledge gathered into an application which has industrial need. Industry-institute collaboration is not new concept, as we all know the world is being more competitive to remain sustain there is need for both industry-institute get involve into collaboration to encourage innovation and competitiveness in global economy. Objective of this paper is to identify whether the industry institute collaboration has significant influence on research & innovation, teaching & learning, employability and knowledge transfer among the engineering institute in pune region; identify the most significant method of knowledge transfer between industry and institute. Proposed study conducted for 10 engineering institutes in the city Pune. Being a survey research the study adopted the use of questionnaires to solicit data from respondents. The population of this study constitutes faculties such as principal, director (R&D), industry institute coordinator, head of department and training placement officer, professor, assistant professor etc. from 10 engineering institutes in pune region. The total sample size of the survey is 224 respondents. From the analysis found that industry institute collaboration have significant influence on research & innovation, teaching & learning, employability and knowledge transfer in engineering colleges in pune region. The most significant method of knowledge transfer was found training of students by industrial personnel, recruitment of personnel from engineering institute, contract research on behalf of industry, research collaborations and use of industrial equipment in engineering institute's labs.

Keywords: industry institute collaboration, knowledge transfer, teaching & learning, research & innovation, employability

1. Introduction

Academic institutes are considered as new source of knowledge for industry where very young minds are working innovative to solve today's industrial problems. Industry-institute collaboration is not new to the world. Research institutes formed partnership with pharmaceutical industries at the end of 19th century. To aid the war energy the research institutes and the scientist got cooperated with national research council of united states throughout world war-I (Jan Bower D. 1993)

1.1. Industry Institute Collaboration Background

The existence of companies based on science and technology, the endless development in technology using science to remain sustain and gain competitive advantage. Increase in cooperation between science and technology are few motives to invoke the partnership between research institutes and industries. The strong collaboration between industries and the research institutes have been contributed to national innovation, economic growth in earlier years. The government research policies heavily highlighting on interaction between industries and institutes for boosting innovation in society. Example of policy institute can receive the

funds and royalties by selling their research intellectual property ownership rights to industries (Adam JD et. Al.,). In the survey of four hundred joint project found that industries ranked their motives in following way: opportunity for new exploration, development of new product, acquire IP and problem solving (Lee long S, 2006). Although there are many reasons for Industries and Institutes who are willing to collaborating with each other by such partnership, well-educated and curious youngsters, professional and expert Faculties, Facilities and innovative technologies are assessable to the Industrial firm. Prime Reason University collaborating with industry found to be additional fund raising for their primary research. University wants faculties and students to provide solution to real problems of industries, creating Employment opportunities for students as well as get hands of experience to applied technology (Frey JH, 1993). Research institutes are beholding for various possibilities to be active players in technology advancement process to secure funds for its expensive research. Industries are finding out the ways to be more competitive in very precarious and speedily changing technological environment. so the engineering institutes are important partner of the industry. This corporation may form in several ways as technical consultancy, research and developments projects, contract research projects and Licensing, Infrastructural support to university such as donation to laboratory equipment, academic level Interaction such as involvement in teaching process, curriculum design (Lewicka D, 2012).

1.2. Why Interaction is so precarious in the knowledge era?

Developing countries started adjusting skills shortages due to the difficulties at workplace bring in quick technological changes, speedy shifts in education and training. Industry-institute communication lets discovering limitless opportunities in working in cooperation and developing a new emphasis to discourse technology-focused. The modern difficulties are the faster momentum of technology which makes skills outdated in shorter period of time. The extreme momentum of technological modifications has stressed the need to incorporate scientific information and expertise in education which expands lifetime competences of a skills-centered employee. Because of rapid improvements in technology fifty percent of the technological skills unconnected within three years, professional skills within ten years and computer skills become unconnected within year. Industry have not always been concerned in getting involved with institute, partnership of institute and industry can only formed by understanding its benefits and motivating management personals.

1.3. Why Industry-Institute Collaboration?

Research institutes must be considered as future industries and organization, which provides solutions to various industrial task, research and problems (Shyamlal, 2010). The collaboration is stage where research institutes as well as industries displays the technological development and its effects on the industry. Research institute partnership with industry can progress the value of professional and technical education. Industries can contribute in professional and educational courses with the goal of interchanging thoughts for organizational growth by close cooperation with institute. Interaction with industry is important to involve the internships and other training program to improve technical learning and teaching process. It helps students to familiarize with practical information, industrial atmosphere and necessary skills; improves student alertness on job roles in the organization. The industry skills requirements for the placement of students can be known by cooperation. Science based Innovation, technologies and engineering determines global Competitiveness and productivity of nations. Industry and institute should involve in research collaboration to inspire innovation and competitiveness in society. Engineering Institute need to take awareness of the varying requirements of industries to develop new course and industry must recognize that sustenance for engineering institute is valuable. Big gains can be had if academic knowledge is paired with the knowledge of the market. Industry academia collaboration can be emphasized to enhance research & innovation, teaching & learning, employability and knowledge transfer.

2. Motivation of Research Work

Engineering institutes have collaborated to industries , it is very important to see this whether this collaboration is useful in providing benefits to institutes in terms of research & innovation, improvement in teaching and learning process, employability of student and success of knowledge transfer between industry and institutes.

3. Research Objective

- Identify whether industry institute collaboration has significant influence on research and innovation in engineering institutes in pune region.
- Identify whether industry institute collaboration has significant influence on teaching and learning in engineering institutes in pune region.
- Identify whether industry institute collaboration has significant influence on employability in engineering institutes in pune region.
- Identify whether industry institute collaboration has significant influence on knowledge transfer in engineering institutes in pune region.
- Identify the most significant method of knowledge transfer between industry and institute.

4. Literature review

This part presents the literature work done by the various researchers and the outcome of the various researches. The important areas of work focused in this research are the industry-institute collaboration impacts on research and innovation, teaching and learning, knowledge transfer and employability.

4.1. *Influence of Industry Institute Collaboration on Research & Innovation*

According to (Albert Banal-Estano, 2010) the educational institute who don't have interaction with industry at all seems to produce less number of research papers compares to those institute who have collaboration with industry. The institute with moderate level of collaboration with industry produced more research papers than institutes which has very high level of industry interaction. Thus adequate interaction with industry is valuable, which enables knowledge transfer, speedup inventions and increases research productivity academic institutes. The important sources of knowledge transfer process were contract research, technical service & consultancy and conferences. (Pallot & Sandoval, 1998) Global partnership projects fetched in optimistic effects on creativity and innovativeness because of a larger variety of expertise as well as reduced costs and lead-time in optimizing solutions based on partners specific knowledge and core competencies. The most important advantage appreciated by industries is an improved entrée to new research and innovations in institutes and the most significant benefits by faculty members is supplementing their own academic research by conservation capitals for researchers and lab equipment and by pursuing visions into their own research. Incubation as in technical progress facilitates ideas, exploration or laboratory process, practical solicitation near introduction for commercial purposes or release. Industry-Institute partnership increases chances for hatching new innovations for the creation of new products.

4.2. *Influence of Industry Institute Collaboration on Teaching & Learning*

In case study of collaboration between CISCO, Microsoft and University of Melbourne found that, Involvement of training programs, workshops have improved the quality of teaching and learning process in academic institutes. The group of multidisciplinary team tackled industrial problems innovatively. The collaboration was helpful for students to gain practical experience and learnt to work through group task. Industry institute collaboration has created real world learning for students. The partnership developed the skills which were required by industrial standard. Industry has developed partnership aimed at modernizing teaching and learning process. Partnership with industry using cross disciplinary team was ground breaking approach to transform teaching and learning process (Haydn Belfield, 2012).

4.3. *Influence of Industry Institute Collaboration on Knowledge Transfer and Employability.*

The program of international design and business management (IDBM) of AALTO University was one year program for management students. In collaboration with Finnish industry; The IDBM Partnership made actual world learning practices for the students. Industrial problems were solved innovatively by students group with different disciplines of education. This outcome produced direct recruitment platform for students. 7% of the services and products arose from collaborated project, which had created value for industrial partner. This collaboration resulted in good knowledge transfer activities between industry and institute (Salimaki M, 2011). Collaboration opens the door to the teaching, learning and employability opportunities with Industry. The partnership with industry has increased the student motivations for learning. Partnership has increased awareness of desired employability skills; faculties understood the expectations of industry in workforce development. Collaboration provided better corporate image and recognition in technical industry (Richard Bukaliy, 2013).

4.4. *Conceptual Framework*

From the above literature review we can see that industry institute collaboration has significant influence of factors such as research & innovation, teaching & learning, employability and knowledge transfer in academic institutes. Below given fig.1 shows the conceptual model on influence of industry-institute collaboration on research & innovation, teaching & learning, employability and knowledge transfer. This was developed from considering all researchers findings.

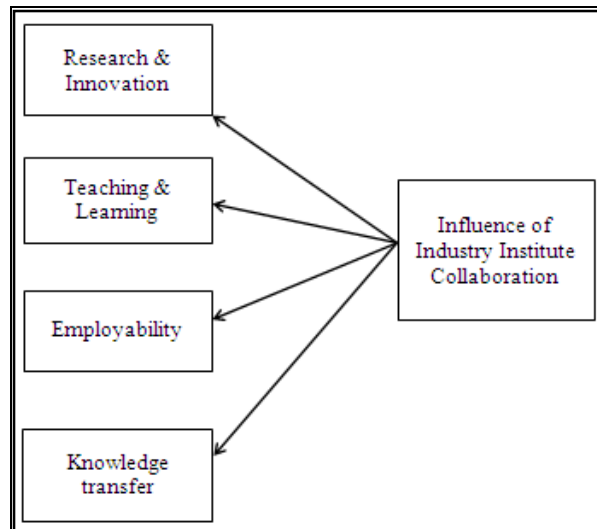


Figure 1: Conceptual Model that represents the influence of Industry-Institute Collaboration

5. Research Methodology

5.1. Development of Hypothesis

5.1.1. Research & Innovation

Hypothesis-1:

- H_0 : Industry-Institute Collaboration does not have significant influence on research and innovation in engineering institutes.
- H_a : Industry-Institute Collaboration has significant influence on research and innovation in engineering institutes.

5.1.2. Teaching & Learning

Hypothesis-2:

- H_0 : Industry-Institute Collaboration does not have significant influence on teaching and learning in engineering institutes.
- H_a : Industry-Institute Collaboration has significant influence on teaching and learning in engineering institutes.

5.1.3. Employability

Hypothesis-3:

- H_0 : Industry-Institute Collaboration does not have significant influence on employability in engineering institutes.
- H_a : Industry-Institute Collaboration has significant influence on employability in engineering institutes.

5.1.4. Knowledge Transfer

Hypothesis-4:

- H_0 : Industry-Institute Collaboration does not have significant influence on knowledge transfer in engineering institutes.
- H_a : Industry-Institute Collaboration has significant influence on knowledge transfer in engineering institutes.

5.2. Development of survey Instrument: Questionnaire-I Design

This survey instrument is developed to receive the believes of head of department, training placement officer, director, principal, assistant professors etc. on benefits received by the Industry-institute collaboration on research & innovation, teaching & learning, employability and knowledge transfer in respective of institute. The first part of the questionnaire is a general introduction and a brief description of the context of Study. The first part of the Questionnaire was consist of 5 Construct which we used to measure the influence of Industry Institute Collaboration on Research and innovation (4 questions), Teaching and Learning (5 questions), Employability (4 Questions), knowledge Transfer (11 Questions) and Output (3 Questions).The Second Part Consist of questions pertaining to Demographic details of respondents. The questions are formed in Likert scale ranging from strongly disagree (1) to strongly agree (5). The questionnaire is as shown in Apendix.1.

5.2.1. Demographic Details

An Initial set of item were designed to get the background information of the respondents filling the questionnaire. This was done to understand if any differences exited in their perception of Collaborative Climate based on their individual's personals details and collaborator related aspects.

5.2.2 .Personal Information

- Gender was captured as male or female.
- Qualification was captured as either graduate, postgraduate, Ph.D.
- Designation was captured as Director, Director (R&D), Industry-Institute Coordinator, Professor, Associate Professor, Assistant Professor, Training Professor Officer, and Scientist.
- Experience in the organization captured as less than 5 Years, 5-10 Years, 11-15 Years, 16-20 Years, more than 20 years.
- Experienced in the Industry-Institute Research Project captured as less than 1 year, 1-3 years, 4-6 years, 7-9 years, more than 10 years.
- Age was captured in the bins of 21-30, 31-40, 41-50, and 51-60. It was decided not to ask the exact age because few respondents felt uncomfortable about revealing their ages during the pilot study

5.2.3. Scale Development

To develop a questionnaire, a five-point Likert scale was constructed with response categories ranging from

- Strongly Disagree
- Disagree
- Neither agrees nor disagrees. (Neutral)
- Agree
- Strongly agree

6. Sample Design

6.1. Target Population

The target populations will Constitutes Engineering institutes in Pune. It is planned to keep sample size 220 out of which min. sample of 70 can be selected for study.

6.2. Sampling Size

Formula for identifying sample size for finite Population:

$$n = \frac{(Z^2 * p * q * N_p)}{(e^2 * (N_p - 1)) + (Z^2 * p * q)}$$

n → Sample Size

Z → 1.96 (as per table of scores in normal distribution within selected range of z for a confidence level of 95%)

p → proportion of defects in the universe (2% of defect in the universe is assumed)

q → (1-p)

e → acceptance error (an error 2% of the value is assumed)

N_p → finite population (No. of Engineering College in pune = 45 * Avg. Teaching faculties)

p = 0.02, q = 0.98, e = .02, Z = 1.96, N_p = 7200, n = 100.

6.3. Sampling Technique

Random sample technique is used to identify the samples. The respondents are the faculties of engineering institutes head of the department, director, director (research & development), training placement officer, industry-institute coordinator, assistant professor, associate professor, professor.

6.4. Sample Identification

the sample of the main study consisted of 224 respondents across 10 engineering in Pune. The Respondents were chosen because of their participation in Research Collaboration Projects and other Industry-Institute Partnership Activities.

6.5. Data Analysis

data analysis involves converting a series of recorded observation into descriptive statement and inferences about relationship. For the statistical analysis of the data used in the present study, the major tool includes SPSS IBM v 20.0. Factor analysis, reliability analysis, paired t-test, mean, averages, pie chart, percentage graph, bar diagrams.

6.6. Pilot Study of Questionnaire

Around 40 respondents were identified within Engineering Institute to answer the questionnaire and the responses were analyzed. These respondents include Head of Respective Departments, Training and Placement officers, director (Research & Development), Assistant Professor, Associate professor, Professors and Industry-Institute Coordinator On their availability for Participation in pilot study. Factor analysis (*Saraph Jayant v., 1989*) used to test the construct validity. For reliability analysis Cronbach's alpha Calculated Using SPSS 20.0 by IBM. Cronbach Alpha for Entire Questionnaire was Came Out to be 0.891. Cronbach Alpha for each of the constructs was found to be greater than 0.6., Table 6.2 shows the cronbach's alpha of all the items in the questionnaire considered together. Table 6.1 was a summary of the individual and total variance explained by the factors.

Factors	% of Variance	Cumulative Variance	Initial Eigen Value
Factor 1	51.17	51.17	13.81
Factor 2	10.79	61.96	2.91
Factor 3	8.21	70.18	2.21
Factor 4	8.05	78.23	2.17
Factor 5	5.07	83.3	1.36
Total variance	83.3		

Table.1: Total variance Explained

Cronbach's Alpha	N of items
0.891	27

Table 2: Reliability of Total Questionnaire Reliability Statistics

Usually, any value for the Cronbach's Alpha greater than 0.6 is seemed to be reliable (J martin Bland, 1997). In this case the value 0.891 provides the reliability of the survey. We also conducted the reliability of each of the construct and the results of this recorded in table below:

Construct Name	Cronbach's Alpha
Research and Innovation	.836
Teaching and Learning	.854
Employability	.664
Knowledge Transfer	.630
Output	.765

Table 3: Construct Reliability

Our reliability Analysis on each construct showed that the cronbach's Alpha is greater than 0.6. This shows that the items used to measure each construct are reliable (J Martin bland, 1997).

7. Result and Analysis

Analysis has been carried out to capture the influence of industry-institute collaboration on the factors such as, research & innovation, teaching & learning, employability and knowledge transfer using the questionnaire which is as shown in Apendix.1.

7.1. Descriptive Statistics of Respondents

From the descriptive statistics it can be concluded that more than half of the respondents had a doctoral qualification (58%) of which, nearly quarter of the respondents were head of the department. More than half of the respondents had experience more than 11 years in engineering institutes and also 80% of respondents had experience working in Research projects for more than one year.

Age Group	frequency	Percent	Cumulative Percent
21-30	49	21.9	21.9
31-40	73	32.6	54.5
41-50	70	31.3	85.7
51-60	32	14.3	100.0
Total	224	100.0	

Table 4: Age wise categorization of respondents

Gender	frequency	Percentage	Cumulative percent
Male	95	42.4	42.4
Female	129	57.6	100.0
Total	224	100.0	

Table 5: Gender wise distribution of respondents

Education	frequency	Percentage	Cumulative percentage
Graduate	1	0.4	0.4
Postgraduate	93	41.6	42.0
PhD	130	58.0	100.0
Total	224	100.0	

Table 6: Education wise distribution of respondents

Designation	frequency	Percentage	Cumulative percentage
HOD	48	21.4	21.4
Director	3	1.3	22.8
Director(R&D)	1	.4	23.2
Principal	1	.4	23.7
TPO	9	4.0	27.7
Professor	21	9.4	37.1
Assistant Professor	105	46.9	83.9
Associate Professor	36	16.1	100.0
Total	224	100.0	

Table 7: Designation wise Distribution of Respondents

Experience	frequency	Percentage	Cumulative percentage
<5	49	21.9	21.9
5-10	60	26.8	48.7
11-15	25	11.2	59.8
16-20	41	18.3	78.1
>20	49	21.9	100.0
Total	224	100.0	

Table 8: Experience Wise Distribution of Respondents

Experience	frequency	Percentage	Cumulative percentage
<1	35	15.6	15.6
1-3	76	33.9	49.6
4-6	59	26.3	75.9
7-9	34	15.2	91.1
>10	20	8.9	100.0
Total	224	100.0	

Table 9: Experience in Research Project Wise Distribution

7.2. Paired T-test to Study the factors affected by industry-institute collaboration

Paired-t test analysis had been carried out to study the influence of industry institute collaboration (IIC) on research & innovation, teaching & learning, employability and knowledge transfer, which were considerate to be the most significant factor influenced by collaboration. Paired t-test compares the mean of the influence of IIC with the research & innovation, teaching & learning, employability and knowledge transfer respectively.

	N	Correlation	Mean	SD	T	p-value
Influence of IIC Research & Innovation	224	.331	4.25 3.83	.523 .601	9.638	0.000*
Influence of IIC Teaching & Learning	224	.356	4.25 4.12	.523 .405	1.006	0.000*
Influence of IIC Employability	224	.398	4.25 4.14	.523 .503	1.897	0.000*
Influence of IIC Knowledge Transfer	224	.757	4.25 4.14	.523 .462	4.495	0.000*

Table10: Result of Paired t-test

* denotes significance of 1%

Hypothesis	Analysis	Result	Summary
Hypothesis-1	$p=0.000<0.01$	H_a accepted	Industry-Institute Collaboration has significant influence on research and innovation in engineering institutes.
Hypothesis-2	$P=0.000<0.01$	H_a accepted	Industry-Institute Collaboration has significant influence on teaching and learning in engineering institutes.
Hypothesis-3	$P=0.000<0.01$	H_a accepted	Industry-Institute Collaboration has significant influence employability engineering institutes.
Hypothesis-4	$P=0.000<0.01$	H_a accepted	Industry-Institute Collaboration has significant influence on knowledge transfer in engineering institutes.

Table 11: Summary on Paired t-test Results

From the results of paired t-test analysis we found that industry institute collaboration has significant influence on the factors research & innovation, teaching & learning, employability and knowledge transfer among the engineering institutes in pune region.

7.3. Most Significant Method of Knowledge Transfer between Industry and Institute

We had done descriptive statistics analysis to calculate the mean for respective method of Knowledge Transfer. The descriptive statistics helped in identifying the most significant method of knowledge transfer method between industry-institute.

We had considered the highest value of mean to identify the most significant knowledge transfer method.

		N	Min.	Max.	Mean	Std. Deviation
Q14.	Training of student by industrial personnel	224	2	5	4.36	.689
Q15.	Recruitment of personnel from engineering institute	224	2	5	4.25	.685
Q16.	Contract research on behalf of the industry	224	1	5	4.17	.764
Q17.	Research collaborations	224	1	5	4.17	.756
Q18.	Use of industrial equipment in university labs	224	2	5	4.16	.650
Q19.	Joint projects based on public funding	224	3	5	4.15	.709
Q20.	Free dissemination of research outputs	224	1	5	4.14	.760
Q21.	Presentations (papers, conference contributions)	224	1	5	4.12	.695
Q22.	Licensing of technology to university partners	224	1	5	4.08	.803
Q23.	Formation of ventures and spin-off companies together with university	224	1	5	4.05	.799
Q24.	Sale of services, data and software to universities	224	1	5	4.00	.828

Table 12: Results of Descriptive Statistics-Mean Values of Knowledge Transfer methods

Form the table it is seen that the Mean for all the method of knowledge transfer is above 4, hence we conclude that 224 subject respondent are agreed on all the methods were suitable to measure success of knowledge Transfer between Industry and Engineering Institute. The most significant method of Knowledge Transfer between Industry-Institute are the training of industrial Person by Academic organization (Mean M=4.36) followed by the Recruitment of personnel from universities (Mean M=4.25), the third and fourth significant method of knowledge transfer are contract research (mean M=4.17) and research collaborations (mean M=4.17) respectively. The fifth significant method of knowledge transfer is use of industrial equipment in university labs i.e. engineering institute labs (mean m=4.16).

8. Conclusion

The aim of this study was to find the influence of industry institute collaboration on research & innovation, teaching & learning, employability and knowledge transfer among the engineering institutes in pune region. Analysis have shown that the industry institute collaboration has significant influence on research & innovation, teaching & learning, employability and knowledge transfer in engineering institutes in pune. Collaboration with industries created real learning experience for student while they were working on industrial problems to provide solutions innovatively. Many faculties form engineering institutes were working on the contract research project to develop products of industry, the partnership helped in developing new products for industry partners. Faculties have agreed that involvement with industry partners in internships, training and workshop programs improved the technical teaching and learning process; students who emerged in industrial internships have known the important skill set and understood their alertness toward job role in industry which created employment opportunities for students of engineering institutes in pune region. From the analysis the most significant knowledge transfer between industry institute was found are ranked according: the training of students by industrial personnel, recruitment of personnel from engineering institutes, contract research on behalf of industry, research collaboration and use of industrial equipment's in engineering institute's labs.

The result of this study would be motivation to engineering institutes in pune region; which do not collaboration with industries. Also this result would be helpful for the engineering institutes to identify whether industry collaboration has significant influence on research & innovation, teaching & learning, employability and knowledge transfer in their institute.

9. Future Scope

This study had been carried in engineering institutes of pune region, Only 10 engineering institutes had participated. It would be helpful if this project is carried at university level for the institute, to know the effect of industry collaboration on engineering institutes.

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11. Appendix.1

Questionnaire

Research and Innovation		1	2	3	4	5
1	Collaboration with Industry partners useful for you to develop new products or services.					
2	Industrial research has high risk and high investments, but Academic research is safe and cost efficient.					
3	Academia-Industry Collaboration helped in Bridging Technology gap between Institutes and Industries.					
4	Multidisciplinary teams tackled industry problems and produced innovative solutions.					
Partnership that impacts teaching and Learning		1	2	3	4	5
5	Industry Develop Partnerships with Institutes specifically aimed at modernizing teaching and learning.					
6	Partnership is developing new skills for a next-generation workforce, conduit for future recruitment of top talent.					
7	Institute-Industry looked at unemployment, mismatch of skills, jobs, and developed long-running individual programs to boost skills in the classroom.					
8	Industry-Institute Collaboration is creating a real-world learning experience for students.					
9	Engagement with industry in using cross-disciplinary teams was a groundbreaking approach to transforming teaching and learning.					
Employability		1	2	3	4	5
10	Industry-Institute Collaboration creates a window on future recruits that could sharply reduce internal training costs.					
11	The Industry- Institute collaboration helps in increasing employment in institutes.					

12	Skills found in fresh graduate and post graduate are matching with current needs of industries.					
13	Industry-Institute Collaboration enhances to train students in company projects with partner companies, establishing a direct recruitment platform for students.					
Knowledge Sharing						
	Are the following methods suitable for measuring the success of the knowledge transfer between industry and academia?	1	2	3	4	5
14	Use of industrial equipment in engineering institute's labs					
15	Presentations (papers, conference contributions)					
16	Free dissemination of research outputs					
17	Research collaborations					
18	Contract research on behalf of the industry					
19	Licensing of technology to university partners					
20	Sale of services, data and software to universities					
21	Formation of ventures and spin-off companies together with university					
22	Joint projects based on public funding					
23	Recruitment of personnel from engineering institute (Internships, PhD students etc.)					
24	Training of students by industrial personnel					
Influence of Industry Institute Collaboration						
25	This collaboration was successful in delivering value to us.					
26	The partner organization further expressed interest to further collaborate with us.					
27	The technical knowhow is enhanced by the collaboration					